to, the *lac* promoter, the *trp* promoter, hybrid promoters such as the tac promoter, the lambda phage Pl promoter. In general, foreign proteins may be produced in these hosts either as fusion or mature proteins. When the desired sequences are produced as mature proteins, the sequence produced may be preceded by a methionine which is not necessarily efficiently removed. Accordingly, the peptides and proteins claimed herein may be preceded by an N-terminal Met when produced in bacteria. Moreover, constructs may be made wherein the coding sequence for the peptide is preceded by an operable signal peptide which results in the secretion of the protein. When produced in prokaryotic hosts in this matter, the signal sequence is removed upon secretion.

A wide variety of eukaryotic hosts are also now available for production of recombinant foreign proteins. As in bacteria, eukaryotic hosts may be transformed with expression systems which produce the desired protein directly, but more commonly signal sequences are provided to effect the secretion of the protein. Eukaryotic systems have the additional advantage that they are able to process introns which may occur in the genomic sequences encoding proteins of higher organisms. Eukaryotic systems also provide a variety of processing mechanisms which result in, for example, glycosylation, carboxy-terminal amidation, oxidation or derivatization of certain amino acid residues, conformational control, and so forth.

Commonly used eukaryotic systems include, but are not limited to, yeast cells, fungal cells, insect cells, mammalian cells, avian cells, and cells of higher plants. Suitable promoters are available which are compatible and operable for use in each of these host cell types. Also available, are termination sequences and enhancers, such as, for example, the baculovirus polyhedron promoter. As described above, promoters can be either constitutive or inducible. For example, in mammalian systems, the mouse metallothionine promoter can be induced by the addition of heavy metal ions.

The particulars for the construction of expression systems suitable for desired hosts are known to those in the art. For recombinant production of the protein, the DNA encoding it is suitably ligated into the expression vector of choice and then used to transform the compatible host which is then cultured and maintained under conditions wherein expression of the foreign gene takes place. The protein of the present invention thus produced is recovered from the culture, either by lysing the cells or from the culture medium as appropriate and known to those in the art.

One having ordinary skill in the art can, using well known techniques, isolate the WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein produced using such expression systems.

In addition to producing these proteins by recombinant techniques, automated amino acid synthesizers may also be employed to produce WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or functional fragments thereof. It should be further noted that if the proteins herein are made synthetically, substitution by amino acids which are not encoded by the gene may also be made. Alternative residues include, for example, the amino acids of the formula $H_2N(CH_2)_nCOOH$ wherein n is 2-6. These are neutral, nonpolar amino acids, as are sarcosine (Sar), t-butylalanine (t-BuAla), t-butylglycine (t-BuGly), N-methyl isoleucine (N-MeIle), and norleucine (Nleu). Phenylglycine, for example, can be substituted for Trp, Tyr or Phe, an aromatic neutral amino acid; citrulline (Cit) and methionine sulfoxide (MSO) are polar but neutral, cyclohexyl alanine (Cha) is neutral and nonpolar, cysteic acid (Cya) is acidic, and ornithine (Orn) is basic. The conformation conferring properties of the proline residues may be obtained if one or more of these is substituted by hydroxyproline (Hyp).

Portions of this disclosure relate to pharmaceutical compositions and other portions of the disclosure relate to therapeutic or prophylactic vaccines. The pharmaceutical compositions of the invention are intended to be administered to an individual for the purpose of killing cells and the vaccine compositions of the invention are intended to be administered to an individual for the purpose of inducing a prophylactic or therapeutic immune response against virus infection. The pharmaceutical compositions of the invention are administered in an amount effective for inducing apoptosis and killing cells. The vaccine compositions of the invention are administered in an amount effective for the purpose of inducing an immune response.

Whether the compositions are being prepared as pharmaceuticals or vaccines, many aspects of the composition, formulation, dosing, and administration of the pharmaceutical compositions and vaccine compositions of the invention are related, and can be identical, as will be readily appreciated by those of skill in the art. For example, both pharmaceutical compositions and vaccines of the invention may comprise WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or a fragment thereof. The capsid protein, or fragment thereof, in the pharmaceutical composition will be functional in apoptosis activity, whereas, the capsid protein, or fragment thereof, in the vaccine will be immunogenic. Portions of the

disclosure concerning related aspects are considered to be relevant to both pharmaceutical compositions and to vaccines.

Pharmaceutical compositions used for treating diseases characterized by hyperproliferating cells comprising a WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or functional fragment thereof, and a pharmaceutically acceptable carrier or diluent may be formulated by one of skill in the art with compositions selected depending upon the chosen mode of administration. Suitable pharmaceutical carriers are described in *Remington's Pharmaceutical Sciences*, *supra.*, a standard reference text in this field.

A common requirement for any route of administration is efficient and easy delivery. In one embodiment of the invention, the pharmaceutical compositions are administered by injection. In a preferred embodiment, the compositions are administered by intra-tumoral injection. Other means of administration include, but are not limited to, transdermal, transcutaneous, subcutaneous, intraperitoneal, mucosal, or general persistent administration.

For parenteral administration, the WNV or other viruses including *Flavivirus* or *Pestivirus* capsid protein, or functional fragment thereof, can be, for example, formulated as a solution, suspension, emulsion or lyophilized powder in association with a pharmaceutically acceptable parenteral vehicle. Examples of such vehicles are water, saline, Ringer's solution, dextrose solution, and 5% human serum albumin. Liposomes and nonaqueous vehicles such as fixed oils may also be used. The vehicle or lyophilized powder may contain additives that maintain isotonicity (*e.g.*, sodium chloride, mannitol) and chemical stability (*e.g.*, buffers and preservatives). The formulation is sterilized by commonly used techniques. For example, a parenteral composition suitable for administration by injection is prepared by dissolving 1.5% by weight of active ingredient in 0.9% sodium chloride solution.

Although individual needs may vary, the determination of optimal ranges for effective amounts of formulations is within the skill of the art. Human doses can also readily be extrapolated from animal studies (Katocs *et al.*, Chapter 27 *In: Remington's Pharmaceutical Sciences*, 18th Ed., Gennaro, ed., Mack Publishing Co., Easton, PA, 1990, which is incorporated herein by reference). Generally, the dosage required to provide an effective amount of a formulation, which can be adjusted by one skilled in the art, will vary depending on several factors, including the age, health, physical condition, weight, type and extent of the disease or disorder of the recipient, frequency of treatment, the nature of concurrent therapy, if required, and the nature and scope of the desired effect(s) (Nies *et al.*, Chapter 3 *In: Goodman & Gilman's*